REMARKS

At the outset applicants wish to thank the Examiner for indication of allowable subject matter in claim 7 which, as suggested, has been rewritten in allowable independent form. The specification, drawings and abstract have also been amended as requested.

Claims 1-12 are in this case. Claim 1 has been amended to more clearly define the invention in relation to the cited art, and claim 7 has been rewritten. The bases for the amendments of claim 1 may be found, for example, at p. 8, lines 19-20 and p. 13, lines 4-13. Claims 1-6 and 8-12 have been rejected.

Claims 1-6 and 8-12 have been rejected under 35 U.S.C. Section 103 as unpatentable over United States Patent No. 5,490,911 issued to Makowiecki *et al.* in view of U.S. Patent No. 3,729,046 to Kennedy *et al.* These rejections are believed inapplicable to the claims as amended.

Applicants' specification teaches the high utility of freestanding reactive multilayer foils. Such foils are composed of hundreds to thousands of alternating layers of thin (1 - 1000 nm) reactive layers forming a freestanding foil of thickness 10 micrometers to 1 cm (p. 8, lines 17-20). They are useful for a wide variety of applications including welding, soldering and brazing.

The specification acknowledges prior art multilayer foils but points out that they are typically attached to a substrate, not in a more useful freestanding form. There are problems in forming thick multilayer foils. Thick multilayer films (10 micrometers - 1 cm) tend to delaminate and crack.

The specification then teaches that this delamination and cracking is due to stress produced in the growth of thick accumulations of alternating layers and that delamination and cracking can be minimized by vapor depositing the layers under conditions chosen to reduce stress (P. 13, lines 3-15). Specifically, the product of stress and thickness should be kept below 1000 N/m (P. 13, line 10). Under these conditions, one can fabricate a thick multilayered foil structure made up of alternating layers that can, upon ignition, react with one another in an exothermic and self-propagating reaction.

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There are no comparable teachings in any of the cited references. The primary reference to Makowiecki, for example, teaches only the deposition of a multilayered structure on a substrate or the reaction of a multilayer structure to form a tape.

The Examiner is correct that Makowiecki appears to describe a freestanding reactive multilayered foil at Col. 5, lines 10-12. ("In addition, the multilayer material may be fabricated as a foil independent of the substrate which can be coiled as of tape and used at places of need.") This cannot, however, be a thick multilayer foil. A multilayer foil of the type described herein would have to have a thickness of less than 10 micrometers for coiling.

Furthermore reading Makowiecki in context shows that this reference at Col. 5 is not to a coil of unreacted foil, but rather to a coil of the reacted product. The "material" referred to in Col. 5 is the "material" referred to in claim 18 which is the reacted ceramic of claim 17. (Otherwise claim 18 is without support in the specification).

In any event, Makowiecki is devoid of any teaching of the problems of delamination and cracking involved in making freestanding reactive multilayer foils having a thickness greater than about 10 micrometers. Moreover Makowiecki and is specifically devoid of any teaching of the limitation in claim 1 that the product of stress and thickness should be kept below 1000 N/m.

Nor can Kennedy be properly combined with Makowiecki to reconstruct applicant's invention. While it is true that Kennedy relates to the formation of foils, the Kennedy foils are single material foils, not reactive multilayer foils. Single material foils do not present the same severe problems of cracking and delamination presented by multilayer foils. Nor do they present the risk of reaction during fabrication.

The Examiner is correct that Kennedy suggests the use of a fluorine salt release agent, but Kennedy suggests that the fluorine salt be used so that the substrate can be heated to a high temperature to make the foil ductile (between 800° K to 1400° K). Such temperatures would cause a multilayer reactive foil to ignite during fabrication. Kennedy makes a different product and deals with different problems, and is therefore nonanalogous to the invention of applicant's claim 1. Kennedy teaches nothing concerning the fabrication of reactive multilayer foil and accordingly is not properly combined with Makowiecki.

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In view of the foregoing it is submitted that claim 1 and the remaining claims dependent thereon, patentably distinguish from Makowiecki and Kennedy. Accordingly this case now fully complies with the provisions of 35 U.S.C. Section 103 and is now in condition for allowance. Reconsideration and favorable action in this regard are therefore earnestly solicited.

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VERSION SHOWING CHANGES MADE

IN THE SPECIFICATION

Amend the second paragraph on P. 1, lines 9 - 16 to read as follows:

This application claims the benefit of United States Provisional Application Serial No. 60/201,292 filed by the present applicants on May 2, 2000 and entitled "Reactive Multilayer Foils". It is related to U.S. Application Serial No. 09/846,447 filed by M.E. Reiss *et al.* concurrently herewith and entitled "Method of Making Reactive Multilayer Foil and Resulting Product" and U.S. Application Serial No. 09/846,422 filed by T.P. Weihs *et al.* concurrently herewith and entitled "Reactive Multilayer Structures For Ease of Processing and Enhanced Ductility". These three related applications are incorporated herein by reference.

Amend the first full paragraph on P. 18, lines 5 - 10 to read as follows:

A reactive multilayer braze is formed that is similar to the reactive foils described above, which reacts to form a metallic glass. This multilayer braze gives off heat upon a reaction of its alternating layers. Through a careful selection of reactants that are known to be good glass formers, the braze will form an amorphous final product upon reaction, similar to those in commercial use and to the foils described above. The heat generated by the reacting braze layers reduces the amount of reactive foil required for joining.

Amend the last paragraph on P. 18 beginning at line 20 and ending on P. 19, line 2 to read as follows:

A semiconductor or microelectronic device is joined to a substrate such as a printed circuit board using a reactive multi-layer foil. Fig. 8 schematically illustrates the joining arrangement wherein the reactive foil 80 is sandwiched

between solder layers 81A and 81B, and the sandwich is disposed between the contact lead 82 for the device 83 and the contact surface 84 of the electronic board 85.

IN THE CLAIMS

Amend claim 1 to read as follows:

1. A method of making a freestanding reactive multilayer foil composed of a plurality of alternating layers that can react exothermically, comprising the steps of:

providing a substrate;

vapor depositing the alternating layers on the substrate to form [the] a reactive multilayer foil having a thickness in the range of about 10 micrometers to about 1 cm, the vapor deposition conditions chosen for low stress so that the product of stress in the film and the film thickness is kept below 1000 N/m; and

separating the multilayer foil from the substrate to provide the freestanding reactive multilayer foil.

Amend claim 7 to read as follows:

7. [The method of claim 1 wherein the substrate comprises a removable sacrificial layer of copper, brass or photoresist.] A method of making a freestanding reactive multilayer foil composed of a plurality of alternating layers that can react exothermally, comprising the steps of:

providing a substrate comprising a removable sacrificial layer of copper, brass or photoresist;

vapor depositing the alternating layers on the substrate to form the reactive multilayer foil; and

separating the multilayer foil from the substrate.